

# Treatment of the Crooked Nose: The Final Steps to Perfection

Michele Pascali, MD,\* Armando Bocchieri, MD,† Francesco Carinci, MD,‡  
and Valerio Cervelli, MD\*

**Abstract:** Perfection is sometimes approached in treatment of the crooked nose today but not fully achieved due to the continued existence of flaws. While the traditional surgical algorithm envisages the use of 2 series of procedures to straighten the nasal bones and cartilaginous septum, the addition of a third appears very useful with a view to obtaining truly excellent results, above all in the case of marked deviation. The authors present their experience in the use of certain procedures designed to correct asymmetry of the upper lateral and lower lateral cartilages, as well as the soft covering tissues where necessary.

A retrospective study was carried out on 105 patients treated for crooked nose over a 3-year period, 90% of the patients being due to trauma and the remaining 10% to congenital malformation. All the patients involved severe deviation of the nasal pyramid.

The mean follow-up period was 18 months (range: 8–36 months). The use of these additional surgical procedures made it possible to obtain excellent final results in 83 (97.6%) patients with crooked nose of traumatic origin and in 17 (85%) patients with crooked nose due to congenital malformation. No major complication was registered, although 3 patients did present minor complications not connected with the nasal deviation.

In conclusion, more modern approach to correction of the crooked nose should involve not only realignment of the osteo-cartilaginous axis but also treatment of the neighboring structures.

**Key Words:** Cartilages, congenital malformation, crooked nose, surgery

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The attainment of perfection for crooked nose still presents a challenge despite the progress obtained by the surgical techniques over the last years.<sup>1–4</sup> The authors take perfect realignment of the septal structure by using methods currently available for granted in this paper. Their working philosophy is essentially based on 3 types of well-established surgical approaches that make it possible to obtain excellent and lasting results, namely

extracorporeal septoplasty,<sup>5,6</sup> spreader graft,<sup>7–9</sup> and the septal cross-bar graft.<sup>10–12</sup>

Despite the appropriate use of corrective techniques, the examination of long-term results in some patients still reveals flaws that make the difference between a good result and perfection. These blemishes essentially regard the upper lateral cartilages, the lower lateral cartilages, and sometimes the soft covering tissues.

In the typical situation of C-shaped crooked nose, the upper lateral cartilage on the concave side often proves to be depressed and shorter with respect to its contralateral counterpart (Fig. 1). This anatomical abnormality is still more evident when the deviation of the nasal pyramid from the midline is linear.

Similarly, the lower lateral cartilages present a series of peculiar characteristics, the most frequent of which include lesser length of the lateral crus on the concave side of the deformity of the nasal pyramid together with greater convexity and length on the other side (Fig. 1A). This asymmetry is made still more evident by the frequently concomitant difference in thickness of the 2 lateral crura.

Nor should we underestimate the problem of the soft covering tissues, which undergo an effect of cutaneous expansion when the deformity has been present for a long time that sometimes leads to an excess on 1 side with respect to the other. The purpose of this paper is to examine these residual deformities and suggest some surgical procedures to correct them and obtain an excellent final result.

## PATIENTS AND METHODS

A retrospective study was carried out on 105 patients, 70 men and 35 women, treated between January 2010 and January 2013. The mean age of the patients was 48.3 (range: 23–70). All patients involved severe deviation of the nasal pyramid, 90% as the result of trauma and 10% of malformation. The study included only patients with at least 8 months of follow-up.

Patients already subjected to a previous operation of rhinoplasty were excluded as well those with only slight deviation of the nasal pyramid (under 5 mm from the midline). Decisions were reached by examining patient photographs in frontal view, drawing a midline, and measuring the distance of the most crooked point from the same.

## Surgical Technique

All the operations were performed under general anesthetic and by means of the open approach. The basic standard procedure involved realignment of the nasal septum<sup>5,7,10</sup> followed by median and lateral osteotomies in accordance with well-established protocols.<sup>2,13–17</sup> Careful evaluation of the cartilaginous structures in the middle and lower thirds of the nasal pyramid was necessary at this point.

## Correction of Anomalies of the Upper Lateral Cartilages

First, extramucosal separation of the upper lateral cartilages from the dorsal septum must be carried out in any patient. Careful

From the \*Department of Plastic and Reconstructive Surgery, University of “Tor Vergata” Rome; †“Nostra Signora della Mercede” Hospital, Rome; and ‡University of Ferrara, Ferrara, Italy.

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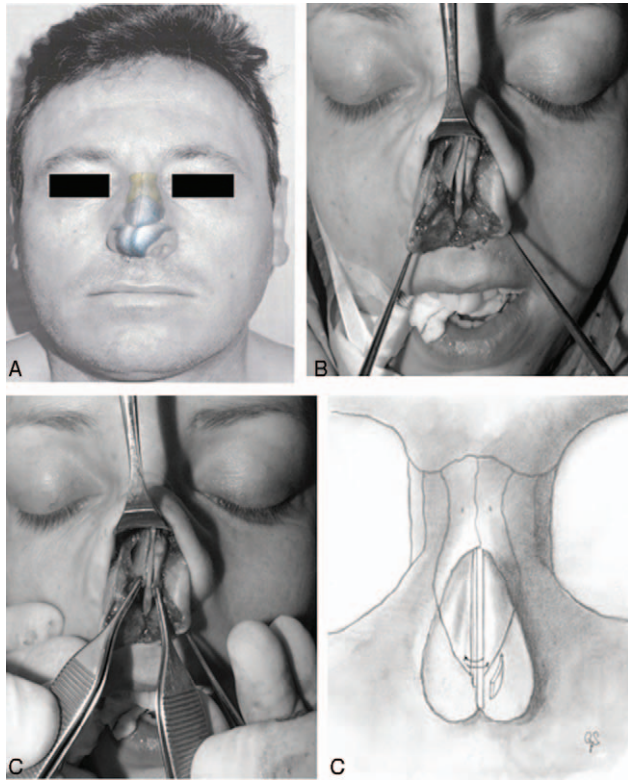
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Address correspondence and reprint requests to Prof Francesco Carinci, MD, Department of Morphology, Surgery and Experimental Medicine, University of Ferrara, Via Luigi Borsari 46, Ferrara 44100, Italy;

E-mail: crc@unife.it; www.carinci.org

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**FIGURE 1.** (A) In the typical situation of C-shaped crooked nose the upper lateral cartilage on the concave side often proves to be depressed and shorter with respect to its contralateral counterpart. The lower lateral cartilages present lesser length of the lateral crus on the concave side of the deformity together with greater convexity and length on the other side. (B) Intraoperative view showing the different shape and length of the 2 upper lateral cartilages. (C) Intraoperative view showing how the degree of lengthwise asymmetry can be evaluated more precisely by gripping the caudal apices of the upper lateral cartilages with 2 forceps and stretching them caudally. (D) Drawing showing the symmetrization of the upper lateral cartilages. Symmetrization is carried out through the extramucosal removal of a triangle with its base toward the dorsal septum. Suturing the longer cartilage prior to removal of the surplus portion makes it possible to perform the latter with absolute precision.

examination of the 2 cartilages can reveal marked asymmetry (Fig. 1B). At this point, the degree of lengthwise asymmetry can be evaluated more precisely by gripping the caudal apices of the upper lateral cartilages with 2 forceps and stretching them caudally (Fig. 1C). The first step is symmetrization of the longer upper lateral cartilage, to which end the shorter upper lateral cartilage is gently stretched toward the anterior septal angle and secured with a single 5.0 Vycril suture between its inferior apex and the dorsal septum. In patients in whom a spreader/crossbar graft is already in place, the suture goes through it. Now that a stable term of comparison has been established, the longer upper lateral cartilage is secured at the same level with another suture. Suturing the longer cartilage prior to the removal of the surplus portion makes it possible to perform the latter with absolute precision. Symmetrization is in fact carried out through the extramucosal removal of a triangle with its base toward the dorsal septum (Fig. 1D).

The shortening of the longer cartilage can sometimes prove insufficient to obtain complete symmetrization, as depression on the concave side (C-shaped deviation) or the same side as the deviation (linear deviation) persists in a large proportion of patients. This depression can be evaluated by eye or by touch after stretching the cutaneous flap back over the cartilaginous structures below. An

onlay graft of crushed septal cartilage can be positioned and sutured (5/0 nylon) onto the upper lateral cartilage where the depression is still present. A second graft can be placed over the first to obtain the desired result.

### Correction of Anomalies of the Lower Lateral Cartilages

It should be stressed that in patients of cephalic resection of the lateral crura, often indicated in the treatment of crooked nose, the importance usually attached to the amount of residual cartilage becomes still greater. As the 2 lower lateral cartilages often differ in shape and thickness, the resection performed must necessarily be asymmetrical.

The next step involves positioning an adequate columellar strut between the 2 medial crura. Correct positioning of the strut makes it possible to stabilize the columella and align it with the midline. Attention can now be focused on asymmetries of the lateral crura and dome. Lesser length of the lateral crus on the concave side is generally associated with greater convexity and length of the one on the other side. The first step involves shortening the longer lateral crus, which can be performed by means of the Kridel overlay technique.<sup>18</sup> When a certain degree of asymmetry persists due to the difference in curvature of the 2 lateral crura, a graft of crushed cartilage<sup>19</sup> can be secured in the desired position on the depressed crus (6/0 nylon). Alternately, the graft can be secured with a mattress suture of Vycril 5.0 all the way through the crus lateral and skin of the nasal vestibule below.

Extreme curvature of the lateral crura can be remedied perfectly by means of a lateral crural strut graft<sup>19</sup> positioned beneath the previously detached vestibular skin and sutured below the lower lateral cartilage. When significant asymmetry of the 2 lateral crura still persists, the lateral crural strut can prove useful to flatten the more convex lateral crus and make it as similar as possible to the other in shape and size. Moreover, the lateral crural strut serves to strengthen a weak lateral crus and improve the efficiency of the external nasal valve at the same time.<sup>20</sup>

Once the columella has been realigned with the midline and the divergence in shape and length of the lateral crura has been corrected, the dome can be addressed. The first step involves an interdomal suture (6/0 nylon). Any slight asymmetry and irregularity that may persist in the area of the dome can be masked by means of Peck-type onlay grafts.<sup>21</sup> To this end, either a graft obtained from the portion of lateral crus previously removed (single or double layer) or a small graft of septal cartilage can prove useful.

### Treatment of the Soft Tissues

Once the internal structures have been optimized, the nose is closed and final careful evaluation is carried out by examining the soft tissues covering the nasal tip and wing. In patients in whom asymmetry of the alar base is still noticeable, the corrective technique of symmetrization involves alar wedge excision,<sup>22</sup> normally performed on the convex side. In patients in whom a reduction of both alar base cartilages proves indispensable, more tissue will be removed on the convex side.

Analysis of the soft tissues does not end with the operation itself but continues for up to 3 months, as a certain degree of asymmetry can still manifest itself after advanced remission of the postoperative swelling. This asymmetry is no longer caused by the cartilaginous structures below but by differing thickness of the skin. Local injections of triamcinolone can serve to reduce the thickness of the cutaneous layer. This should be carried out with a 30 G needle directly into the subcutaneous tissue to avoid injection into the dermis, which could result in unsightly patches of cutaneous atrophy.<sup>23</sup>

**TABLE 1.** The Utrecht Questionnaire for Outcome Assessment in Aesthetic Rhinoplasty (Lohuis et al<sup>24</sup>)

**First part**

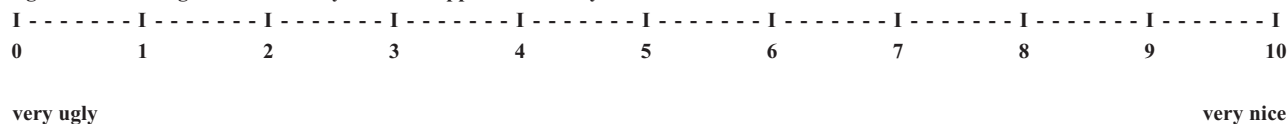
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E1. Are you concerned about the appearance of your nose?				
Not at all	A little	Moderate	Much or often	Very much or often
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E2. Does this concern bother you often?				
Not at all	A little	Moderate	Much or often	Very much or often
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E3. Does this concern affect your daily life (eg, your work)?				
Not at all	A little	Moderate	Much or often	Very much or often
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E4. Does this concern affect you relationships with others?				
Not at all	A little	Moderate	Much or often	Very much or often
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E5. Do you feel stressed by the appearance of your nose?				
Not at all	A little	Moderate	Much or often	Very much or often
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Second part**

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**I give the following score to the way I like the appearance of my nose**



The first part of the questionnaire consisted of 5 questions (E1–E5) about body image and quality of life in relation to nasal appearance. As each of the 5 questions was scored on a 5-point Likert scale (from 1, not at all, to 5, very much/often), the overall minimum and maximum were respectively 5 and 25 points. E3 and E4 were “trick questions” included to reveal any disturbance in body perception or body dysmorphic disorder. The second part of the questionnaire consisted of a 10-point visual analogue scale (from 0, very ugly, to 10, very nice) for patients to rate the appearance of their nose.

The protocol adopted by the authors involves an injection of 0.1 to 0.2 mL of triamcinolone acetonide (10–40 mg/mL). The procedure can be carried out a maximum of 4 times at 2-week intervals.

**Subjective and Objective Evaluation**

Subjective and objective methods were used. The subjective method involved a self- assessment questionnaire<sup>24</sup> (Table 1) together with an explanatory letter after a 1-year follow- up period, once surgical results were considered stable. The first part of the questionnaire consisted of 5 questions (E1–E5) about body image and quality of life in relation to nasal appearance.

The second part of the questionnaire consisted of a 10-point visual analogue scale for patients to rate the appearance of their nose. An identical questionnaire was completed by patients in the postoperative period not more than 1 year later.

Differences between preoperative and postoperative scores were evaluated by paired *t* test. The statistical significance level was set at *P* < 0.05.

Objective evaluation was carried out by 3 independent observers—a plastic surgeon, a maxillofacial surgeon, and an otolaryngologist—uninformed of this study and the surgical techniques employed. The observers were asked to give a score from 0 to 10 for the final results globally evaluated (Table 2). They were then

asked to judge whether deviation was still present in 1 or more portions of the nasal pyramid.

All patients were evaluated by examining full-face frontal, oblique, lateral, and axial views. The images were presented on PowerPoint slides (Microsoft, Redmond, WA), each case lasting 30 seconds.

**RESULTS**

The mean duration of postoperative follow-up was 18 months (range: 8–36 months). Indeed, the additional procedures described in this paper have been proven in cases considered stable over time, even in the longer-term results (24–36 months). Representative patient examples are shown in Figures 2 and 3. Table 3 shows the various surgical procedures used. These procedures gave excellent end results in 83 (97.6%) patients with crooked nose of traumatic origin. In 2 (2.4%) patients, asymmetry of the lower third of the nasal pyramid persisted, probably because resorption of the cartilaginous grafts proved greater than expected. Optimization was achieved in 17 (85%) of the patients of crooked nose due to congenital malformation. In the remaining 3 (15%) the improvement in the situation fell below absolute perfection. A certain degree of asymmetry was found in the middle third and especially the depressed upper lateral cartilage in 1 patient and in the lower

**TABLE 2.** Questionnaire Used by the Observers to Evaluate Surgical Outcomes (Objective Evaluation)

Question	Answer									
	Poor					Moderate		Excellent		
1. Final result (rating scale)	1	2	3	4	5	6	7	8	9	10
2. Is the nasal pyramid deviated? If yes, where?			Yes					No		
			In the third superior					105 (100%)		
			In the third middle							
			In the third inferior							
3. Do you notice asymmetries in the final results? Is yes, where?			Yes					No		
			5 (4.8%)					100 (95.2%)		
			In the third superior: 1							
			In the third middle							
			In the third inferior: 4							
			4 (3.9%)							
4. Do you think that this asymmetries are crucial to judgeb the final result excellent?			Yes					No		
			4 (3.9%)					101 (96.1%)		

Objective evaluation was carried out by 3 independent observers: a plastic surgeon, a maxillofacial surgeon, and an otolaryngologist uninformed as to the aim of this study and the surgical employed. The plastic surgeon and maxillofacial surgeon evaluators were not coinvestigators.

third in the other 2 patients, probably due to the persistence of some dysmorphic element connected with the original cause.

### Subjective Evaluation

Table 4 shows the improvement in the visual analogue scale. No negative scores are recorded and all of the patients regarded the appearance of their nose as improved 1 year after surgery (range: 2–10). The mean improvement was 6.87 points and 92.3% of the patients gave a ranking of between 6 and 10 points. Moreover, no patients reported additional defects or changes in the postoperative period. Table 4 also shows the average scores for the 5 questions (E1–E5). The scores of all individual questions dropped significantly after surgery, indicating a change in subjective perception of nasal appearance.

### Objective Evaluation

The mean scores were 8.1 ± 0.6 for the plastic surgeon, 8.3 ± 0.3 for the maxillofacial surgeon, and 7.9 ± 0.7 for the otolaryngologist. The responses of all 3 independent observers were 100% positive as regards the positioning of nasal pyramid. Five (4.8%) asymmetries were reported (1 in the third middle and 4 in the third inferior). In 4 patients (3.9%) these asymmetries were judged crucial to judge the final result excellent.

### Surgical Complications

No major complications were reported. Pollybeak deformity of the supratip area was found after 3 months in 2 patients, one of whom was successfully treated with 3 injections of triamcinolone acetonide at intervals of a fortnight which the other required surgical revision. In 1 patient a graft of crushed cartilage on the upper lateral cartilage on the concave side proved visible and perceptible to touch. Revision surgery was carried out after 6 months with excellent results.

The cause of this complication was probably imperfect shaping/rounding of the edges of the graft combined with insufficient crushing of the cartilage and thin skin.

### DISCUSSION

In the treatment of the crooked nose, symmetrization of any residual deformities of the upper lateral and lower lateral cartilages constitutes yet a challenge. Though correctly executed even in markedly crooked septum, operations can often fail obtaining excellent results due to stubborn flaws affecting the upper lateral cartilages, the lower lateral cartilages, and the soft covering tissues.<sup>20</sup> While the attention has focused over years on correcting deviation of the osteocartilaginous framework, careful examination of the literature reveals that less importance has been attached to correcting residual defects of other adjoining structures.

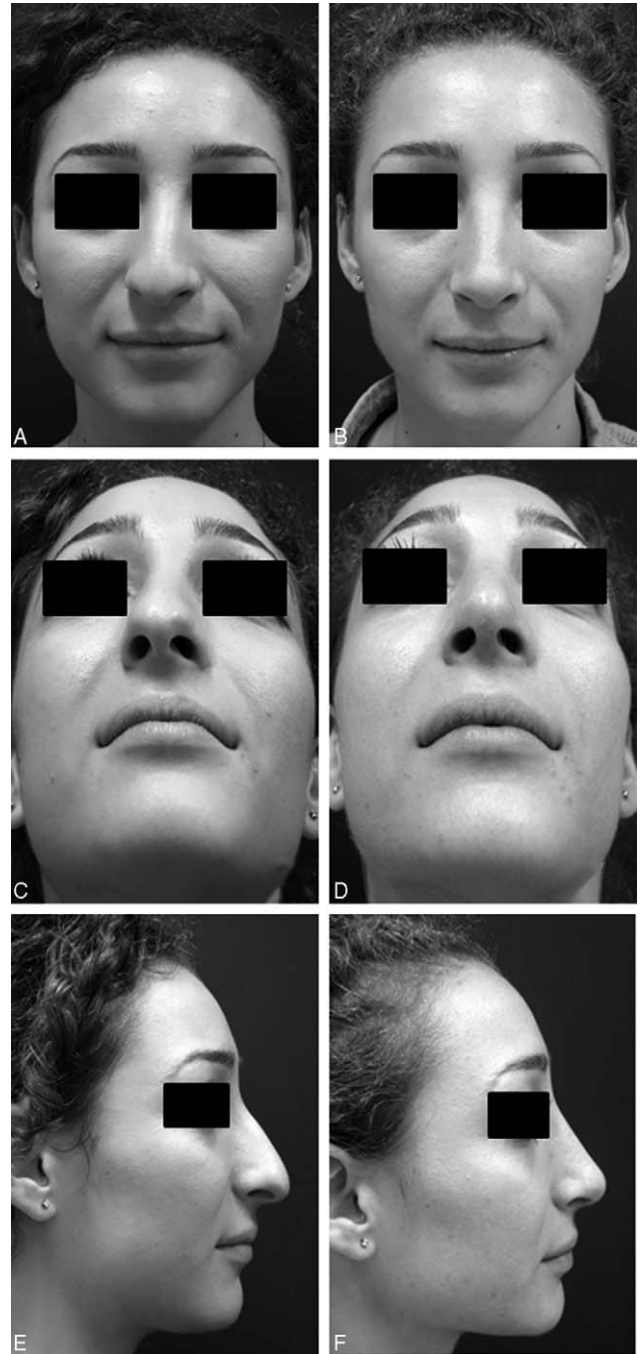
Some authors have raised the question and reported their solutions. In his analysis, Adamson<sup>20</sup> suggests that the most common asymmetries of the nasal tip in patients of crooked nose are often the direct result of an intrinsic asymmetric shape of the lower lateral cartilages. He puts forward a series of surgical procedures used separately or in combinations to obtain complete symmetrization of the nasal tip.

Antunes and Goldstein<sup>3</sup> agree that the crooked nose is a challenge even for the most expert nasal surgeons and suggest that grafts are most commonly used to support a weak, distorted lower lateral cartilage. Pontius and Leach<sup>25</sup> focus on the typical deformities of the upper lateral cartilages and suggest the separate or combined use of a number of techniques, the most original of which involves asymmetric clocking sutures between the upper lateral cartilages and the nasal septum. The purpose appears, however, to be realignment of the septum with the midline rather than modification of the shape and degree of asymmetry of the upper lateral cartilages. The same solution has been adopted by other authors to create asymmetric vectors of forces pulling the middle nasal vault in the desired direction.<sup>5,26</sup>

When all standard steps have already been performed and an evident asymmetry still remains, Stepnick and Guyuron<sup>27</sup> suggest the use of camouflaging onlay grafts. The present authors regard careful analysis of the upper lateral and lower lateral cartilages, both preoperative and intraoperative, as unquestionably innovative in the treatment of crooked nose and worthy of attention. In patients of



**FIGURE 2.** (A) Preoperative frontal view of a 58-year-old man with the typical situation of C-shaped crooked nose after previous nasal trauma. (B) Frontal view of the same patient 12 months after correction. Observe the markedly deviation of the 2 inferior thirds of the nose. (C) The severe caudal septal deviation can be clearly observed on the basal view. (D) The postoperative basal view shows a correct realignment of the caudal septum along the midline. (E) Preoperative lateral view of the same patient. (F) Twelve-month postoperative lateral view after the procedure. Surgery: extracorporeal septoplasty and osteotomies were combined with excision of upper lateral cartilages excess, onlay graft on the contralateral depression, unilateral crural overlay technique on the left side, onlay tip graft on the right side.



**FIGURE 3.** (A) Preoperative frontal view of a 26-year-old woman with the lelear deviation to the right of the lower two-thirds of the nasal pyramid. (B) Frontal view of the same patient 18 months after correction. Observe the evident greater length of the right upper lateral cartilage in comparison with the left side. (C) Preoperative basal view and (D) postoperative basal view. (E) Preoperative lateral view of the same patient. (F) Eighteen-month postoperative lateral view after the procedure. Surgery: spreader graft on the right side and osteotomies were combined with excision of upper lateral cartilages excess, bilateral asymmetrical lateral crural overlay technique, onlay tip graft. Local injection of triamcinolone into the subcutaneous tissue of the left side was carried out for 3 times postoperatively.

**TABLE 3.** Surgical Procedures Used and the Relative Percentages in Relation to the Different Structures Treated

Correction of the Upper Lateral Cartilages	Correction of the Lower Lateral Cartilages	Treatment of the Soft Tissues
Excision of excess 78 (82%)	Overall technique	Alar wedge excision
	Unilateral 22 (23%)	Unilateral 14 (15%)
	Bilateral asymmetrical 45 (48%)	Bilateral asymmetrical 11 (12%)
Onlay graft 74 (78%)	Lateral crural onlay graft 66 (70%)	Local injection of Triamcinolone 60 (63%)
	Lateral crural strut	
	Unilateral 27 (29%)	
	Bilateral 11 (12%)	
	Onlay tip graft 71 (75%)	

marked deviation of the lower two-thirds of the nose, preoperative clinical and photographic analysis will make it possible to foresee the presence of typical deformations of the upper lateral and lower lateral cartilages. Such deformities can sometimes appear different in nature or degree, however, once the septum has been straightened.<sup>20</sup> It is only at this point that full understanding becomes possible of the extent to which asymmetries of the structures adjoining the nasal septum are responsible for residual deformities.

In particular, the upper lateral cartilages, whose importance is often underestimated, consist of tissue that is extremely thin and hard to reshape. They often prove to differ in shape, length, and thickness in patients of crooked nose, and the techniques traditionally most recommended may prove incapable of solving this problem.

Experience has shown that the use of some additional procedures in the final phase of the operation can serve to achieve the desired results. The stretching of the upper lateral cartilages, the use of a single separate and sequential suture, and the removal of caudal excess are some of the key steps. Palpation plays a crucial part in the attainment of perfect symmetry of the middle nasal vault, as any slight differences between the 2 sides of the nasal pyramid remaining once the cutaneous flap has been replaced can be detected with the fingertips. In this patient, symmetrization of the upper lateral cartilages can be completed by means of a camouflage overlay graft. These grafts are capable of correcting residual asymmetries and giving the final appearance of a perfectly straight nose. As regards correction of the lower lateral cartilages, the literature contains countless techniques making it possible to vary every possible and imaginable parameter (projection, position, rotation, etc.).<sup>28-31</sup> Reference is therefore made in these patients not to any one technique in particular but to the use of the most appropriate technique or combination of techniques in relation to the deformation present. Moreover, the peculiar nature of the crooked nose unquestionably makes the use of different procedures

on either side necessary. The use of a lateral crural overlay graft<sup>18</sup> on one or both sides certainly proves effective in adjusting the length of the 2 lateral crura, as do the use of a lateral crural strut graft<sup>19</sup> on 1 side to adjust curvature and flatten 1 of the 2 lateral crura, and grafts on the lateral crura<sup>19</sup> or the dome.<sup>20</sup>

The literature gives little space to the correction of the upper lateral and lower lateral cartilages in patients of crooked nose but still less to treatment of the soft tissues. Asymmetric reduction of the alar base is one of the most obvious and immediate ways of addressing the crooked nose. In this patient, the present authors recommend procedures that avoid interruption of the nostril.<sup>22</sup>

Finally, the last tool available for the treatment of the soft tissues is the injection of triamcinolone acetonide. While the cutaneous injection of this substance is most often mentioned in the literature for the correction of the pollybeak supratip deformity,<sup>23</sup> the same mechanism of action can be exploited through injections on 1 side of the lower two-thirds of the nose when a certain degree of residual thickening of the cutaneous tissue manifests itself.

The repeated injection of triamcinolone can make it possible to obtain retraction and reduce the thickness of the skin by 1 to 2 mm, thus correcting a small residual flaw and making it possible to obtain an excellent result.

### CONCLUSIONS

To achieve perfection in the treatment of the crooked nose crucial importance can attach in this connection to the use of additional procedures to address asymmetry of the upper lateral cartilages, the lower lateral cartilages, and the soft covering tissues.

The consequence of the described treatment, which extends also to these neighboring structures, is the achievement of an excellent result in any particular and it is stable overtime.

The correction of crooked nose should therefore involve not only realignment of the osteocartilaginous axis but also treatment of the adjoining structures.

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**TABLE 4.** Comparison of Preoperative and One-Year Postoperative Scores

Questions	Preoperative Score	Postoperative Score	P Value
E1	4.534	1.129	<0.01
E2	3.980	1.234	<0.01
E3	3.864	1.578	<0.05
E4	3.459	1.023	<0.05
E5	3.629	1.098	<0.01
VAS score	3.456	8.954	<0.001

Differences between preoperative and postoperative scores were evaluated by means of a paired *t* test. The statistical significance level was set at *P* < 0.05. Statistical analysis was performed using Statview software from the SAS Institute.

VAS, visual analogue scale.

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